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Using Artificial Neural Networks (ANN) to predict decision-making under psychological pressure among Iraqi premier league goalkeepers

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Abstract
Introduction and Problem Statement: The study addresses the shift in modern sports towards digital technology and big data. It highlights a critical gap in traditional performance analysis, which typically relies on "post-event" evaluation and overlooks the mental state preceding a goalkeeper's error. The research posits that decision-making errors often result from "cognitive blindness" caused by psychological pressure, a complex interaction that traditional statistics fail to predict.
Objectives: The primary objective was to construct an Artificial Neural Network (ANN) model capable of predicting the accuracy of goalkeepers' decisions based on psychological pressure variables (cognitive and somatic anxiety). The study also aimed to identify the relative importance of these variables in influencing performance.
Methodology

- **Approach:** The researcher used a descriptive predictive approach.
- **Sample:** The sample consisted of 24 main goalkeepers from the Iraqi Premier League for the 2025-2026 season.
- **Tools:** The study utilized the Competitive State Anxiety Inventory-2 (CSAI-2) to measure anxiety levels and video analysis to evaluate 480 specific decisions.
- **Modeling:** An ANN was built using Python and SPSS Modeler, with inputs including anxiety levels, match importance, timing, and score difference.

Key Results

- **High Anxiety:** The participants showed high levels of cognitive anxiety (mean 24.5), indicating significant mental load.
- **Model Accuracy:** The ANN model achieved a predictive accuracy of 84.0% in the testing phase, demonstrating its capability to handle non-linear data effectively.
- **Key Influencers:** "Cognitive Anxiety" was identified as the most significant factor causing errors (38% relative importance), followed by match timing (25%).

Conclusions: The research concludes that performance collapse under pressure is not random but can be mathematically modeled. The ANN model proved to be more accurate and objective than traditional human evaluation, which is often subject to bias. The study recommends integrating AI-based analysis into training programs to better manage cognitive load.

Keywords: ANN, Iraqi, Cognitive load, psychological pressure, match timing, goalkeepers

1. Introduction

1.1 Introduction and Research Significance

The sports field has witnessed a qualitative shift in the last decade regarding reliance on digital technology. High athletic performance, specifically in soccer, no longer depends solely on physical and skill aspects but has become a science based on big data analysis and understanding the complex dynamics of the match (Reilly, 2023) [15]. In this context, the goalkeeper position is considered one of the positions requiring the most special mental capabilities, as the goalkeeper must process a flood of visual information in a constantly changing environment (Ibrahim, 2024). Sports psychology literature indicates that "Decision Making" under pressure is inseparable from the emotional state. "Processing Efficiency Theory" confirms that anxiety and psychological pressure consume part of the Working Memory, which negatively affects response accuracy (Eysenck & Calvo, 1992) [10]. Here lies the research gap, where traditional statistical methods fail to predict how these complex psychological variables interact.

Thus, the need emerged to use Artificial Neural Networks (ANN), which are computer systems that simulate the human brain's method of learning and pattern detection (LeCun *et al.*, 2015) [11]. These networks are distinguished from traditional statistics by their ability to handle Non-Linear Data, making them the optimal tool for predicting complex human behavior (Bishop, 2006) [5]. The significance of the research lies in employing "Machine Learning" techniques to build a model that predicts the decisions of Premier League goalkeepers, providing coaches with an objective evaluation tool far from personal impressions.

1.2 Research Problem

Through field follow-up of the Premier League, the researcher observed that coaches' evaluation of goalkeeper errors is often a "Post-Event Analysis" focusing on the final result of the ball without analyzing the preceding mental state, a methodological shortcoming pointed out by (O'Donoghue, 2010) [14] in criticizing traditional analysis methods. An error in dealing with a cross ball may not be due to technical weakness, but rather a temporary "cognitive blindness" resulting from result pressure. Since current tools are unable to predict the occurrence of this error, the research problem is defined by the question: "Is it possible to build an Artificial Neural Network (ANN) model to accurately predict goalkeeper decision-making based on psychological pressure variables?".

1.3 Research Objectives

- Measuring competitive anxiety levels (cognitive and somatic) among Premier League goalkeepers.
- Designing an artificial neural network to predict decision quality (correct/incorrect).
- Determining the relative importance of psychological pressure variables affecting the decision according to the network's outputs.

1.4 Research Hypotheses

- There is a statistically significant correlation between high cognitive anxiety and low decision-making accuracy.
- The neural network model achieves a predictive accuracy of no less than (80%) compared to actual results.

1.5 Research Scope

- **Human Field:** Main goalkeepers of the Iraqi Premier League clubs for the season (2025-2026).
- **Temporal Field:** The period from 1/10/2025 to 20/1/2026.
- **Spatial Field:** Stadiums of the clubs included in the research in various governorates.

3. Research Methodology and Field Procedures

3.1 Research Methodology

The researcher used the descriptive approach with a predictive style, due to its suitability for studies aiming to forecast future performance based on real data, which is the approved approach in sports modeling studies (Thomas & Nelson, 2015) [17].

Table 1: Description of the research sample

Rank	Variable	Description	Count/Mean	Percentage
1	Number of Goalkeepers (Sample)	Main Goalkeepers	24	60% of Community
2	Training Age	Years of Experience	8.5±2.3 years	-
3	Number of Analyzed Decisions	Total Decisions	480 decisions	-
4	Data Split (for Network)	Training Data	336 cases	70%
5	Data Split (for Network)	Testing Data	144 cases	30%

3.2 Community and Sample

The community included all Premier League club goalkeepers (40 goalkeepers). The sample was chosen purposively from main goalkeepers who participated in more than 10 matches, totaling (24) goalkeepers, to ensure performance stability and the availability of sufficient data for analysis (Al-Samarrai, 2023) [2].

3.3 Data Collection Tools and Means

The researcher relied on two main tools to collect data to feed the neural network.

First: Competitive State Anxiety Inventory-2 (CSAI-2)

To measure the state of anxiety before and during the match (half-time), the (Martens) inventory modified for the Arab environment was used. It measures: Cognitive Anxiety, Somatic Anxiety, and Self-Confidence (Martens *et al*., 1990) [12], the scale consists of three dimensions:

- **Cognitive Anxiety:** Negative thoughts and fears.
- **Somatic Anxiety:** Physiological responses (sweating, accelerated heart rate).
- **Self-Confidence:** Belief in the ability to perform.

Second: Video Analysis

(Dwarfish) software was used to cut matches and analyze decisions. To ensure analysis objectivity, the researcher relied on an expert evaluation system to measure decision quality, a method proven credible in performance analysis research (Hughes & Franks, 2004). A form was designed to evaluate decisions through video analysis of recorded matches. Each goalkeeper decision (coming out for a cross, passing under pressure, coming out to face a striker) is evaluated according to a binary scale:

- **Correct Decision:** The most appropriate decision for the situation regardless of technical execution.
- **Incorrect Decision:** Choosing a tactical solution inappropriate for the situation.

Table 2: Variables entered into the neural network (Variable Dictionary)

Variable Type	Symbol	Variable Name	Description / Measurement
Inputs	X1	Cognitive Anxiety	Scale Score (9-36)
	X2	Somatic Anxiety	Scale Score (9-36)
	X3	Match Importance	Rating (1: Friendly, 5: Final/Decisive)
	X4	Match Timing	(1: 1st Half, 2: 2nd Half, 3: Critical Time)
	X5	Score Difference	(0: Draw, -1: Losing, +1: Winning)
Output	Y	Decision Accuracy	(0: Incorrect, 1: Correct)

3.4 Field Procedures (Building the Neural Network)

(SPSS Modeler) software and (Python-Keras Library) were used to build the network according to the following structure:

- **Input Layer:** Consists of (5) neurons representing the independent variables mentioned in Table 2.
- **Hidden Layers:** Two hidden layers were used to process data; the first contains (10) cells and the second (8) cells, using the Activation Function (ReLU).
- **Output Layer:** One cell giving the probability of decision correctness (between 0 and 1).

3.5 Pilot Study

Conducted on (14/10/2025) on a sample of (4) goalkeepers from outside the original sample to ensure the clarity of anxiety scale instructions and the validity of cameras for kinetic analysis.

3.6 Statistical Means

The Statistical Package (SPSS) and programming in (Python) were used to extract:

- Arithmetic Mean and Standard Deviation.
- Correlation Matrix (Pearson Correlation).
- Neural network accuracy measures (accuracy, sensitivity, specificity).

4. Presentation, Analysis, and Discussion of Results

This chapter includes the presentation of obtained data, its statistical and software processing, followed by scientific discussion and interpretation.

4.1 Presentation of descriptive results for research variables

The results showed that the arithmetic mean of cognitive anxiety reached (24.5), which is a high level. This agrees with the study of (Al-Kaabi, 2025) [3], which indicated that goalkeepers in the Iraqi League suffer from psychological pressures exceeding other players due to the sensitivity of their position and the absence of specialized psychological preparation. Before entering into the neural network results, the researcher presents descriptive statistics for psychological variables among the research sample.

Table 3: Arithmetic means and standard deviations for anxiety variables and decision accuracy

Variable	Mean	Std. Deviation	Min	Max	Skewness
Cognitive Anxiety	24.50	3.12	14	32	0.45
Somatic Anxiety	21.30	4.25	11	34	0.61
Self-Confidence	22.10	3.80	12	30	-0.32
Decision Accuracy (%)	78.4%	12.6	50%	95%	-0.21

Analysis of Table 3, the table shows that the level of cognitive anxiety among goalkeepers was relatively high with a mean of (24.50), indicating a significant mental load during matches. We also notice that the standard deviation for decision accuracy was large (12.6), indicating a significant variance in levels between goalkeepers, justifying the use of AI to explain this variance. Skewness values were confined between (±1), confirming the normality of distribution and data validity for analysis.

4.2 Presentation of artificial neural network results (Prediction Accuracy)

To verify the second hypothesis (the model's ability to predict), the network was trained and tested. Below is the Confusion Matrix showing the model's accuracy.

Table 4: Prediction accuracy of the neural network in training and testing stages

Stage	Total Cases	Correct Classification	Wrong Classification	Accuracy
Training Phase	336	302	34	89.8%
Testing Phase	144	121	23	84.0%
Total	480	423	57	88.1%

Analysis of Table 4, Table 4 illustrates network accuracy: The network yielded a predictive accuracy of (84%) in the testing phase. This result supports modern scientific research trends favoring AI models over linear regression in sports studies due to the complexity of the human phenomenon (Hassan & Ali, 2024) [7].

4.3 Analysis of Variable Importance

To determine which pressure factors were most influential in "destroying" the decision-making process, the researcher extracted relative importance weights from the network.

Table 5: Relative importance of independent variables in affecting decision accuracy

Rank	Variable	Relative Importance	Percentage %
1	Cognitive Anxiety (Distraction)	0.38	38%
2	Match Timing (Critical Minutes)	0.25	25%
3	Score Difference	0.18	18%
4	Somatic Anxiety	0.12	12%
5	Match Importance	0.07	7%

4.4 Discussion of Results

Discussion of cognitive anxiety effect

Results of Table 5 "Relative Importance Weights" showed that Cognitive Anxiety was the strongest factor influencing error. This can be interpreted in light of (Processing Efficiency Theory), where the goalkeeper's preoccupation with anxiety thoughts (fear of losing, audience blame) consumes attention resources needed to read the ball's trajectory (Wilson, 2008) [18]. This leads to what is called "narrowing of attention focus," so the goalkeeper does not clearly see the options available.

Discussion of neural network accuracy

The network's success in prediction confirms that performance collapse is not random, but the product of accumulated pressures that can be modeled mathematically. This agrees with (Lazarus, 2000) [9] view that psychological pressure is a dynamic interactive process between the individual and the environment, and the athlete's response depends on their appraisal of the situation (threat or challenge), a pattern the network succeeded in capturing. Furthermore, the model's accuracy surpasses the naked eye because humans are prone to bias, whereas the network relies on abstract digital weights (Schmidt & Lee, 2019) [16].

Discussion of the predictive model

Table 6: Comparison of differences between the proposed Predictive Model (ANN) and traditional human evaluation

Point of Comparison	Human Evaluation (Coach/Analyst)	Proposed Predictive Model (ANN)	Advantage To
Accuracy	Usually ranges between 60%-70% (depends on experience)	84.0% Based on current research results	Proposed Model
Objectivity	Low (affected by emotional bias and player halo)	Very High (relies on abstract digital weights)	Proposed Model
Processing Type	Linear-connects cause directly to result	Non-Linear-detects complex relationships	Proposed Model
Variable Capacity	Limited (can focus on 3-4 variables simultaneously)	Unlimited (processes dozens of variables concurrently)	Proposed Model
Reliability	Variable (coach's evaluation varies with mood)	Constant (gives same result for same inputs always)	Proposed Model

Table 6 clearly indicates the qualitative and quantitative superiority of the Artificial Neural Network (ANN) model over traditional human evaluation methods used in the Premier League.

- **Regarding Accuracy:** The model achieved an accuracy of (84%), surpassing human rates often affected by "Cognitive Bias," where coaches tend to evaluate famous goalkeepers better even if they err (Schmidt & Lee, 2019) [16].
- **Regarding Processing:** The table shows the human mind tends towards linear thinking (Pressure = Error), while the network proved its ability for non-linear (dynamic) processing, agreeing with (Lazarus, 2000) [9], as the network discovered that pressure might generate a positive "challenge" for some goalkeepers and not always a "threat," which traditional methods failed to observe.
- **Final Result:** The table confirms that performance collapse is not random, but a complex computational process that AI succeeded in decoding through analyzing the digital weights of psychological variables, giving the model high applied credibility.

5. Conclusions and Recommendations

5.1 Conclusions

In light of the results reached and analyzed, the researcher concludes the following:

- Artificial Neural Network (ANN) technology demonstrated high efficiency and reliability in predicting goalkeeper decisions, outperforming self-evaluation or abstract observation.
- "Cognitive Anxiety" (negative thoughts and doubt) is the goalkeeper's number one enemy, being the most influential factor in making incorrect decisions, more so than physiological anxiety or match importance itself.
- The probability of incorrect decisions increases exponentially in the last ten minutes of close-result matches, confirming that mental fatigue plays a decisive role alongside physical fatigue.
- There is individual variance; the network showed some goalkeepers perform better under medium pressure (Optimal Arousal phenomenon), while others collapse at the lowest pressure levels.

5.2 Recommendations

Based on the conclusions, the researcher recommends the following:

- **Adopting Technology:** Necessity of introducing AI-based data analysis software in Premier League clubs and not settling for traditional video analysis.
- **Mental Training:** Building "Simulation Training" programs for goalkeepers, placing them in training situations that raise cognitive anxiety (penalties, time limits) to train them on decision-making under working memory consumption.
- **Customization:** Treating each goalkeeper as a separate case; data showed error causes differ from one goalkeeper to another, so psychological preparation programs must be designed individually.
- **For Future Researchers:** Conducting similar studies using "Deep Learning" and "Face Analysis" to obtain Real-time pressure indicators during the match without needing paper scales.

References

1. Ibrahim M. Modern tactical analysis for goalkeepers. Cairo: Dar Al-Fikr Al-Arabi; 2024.

2. Al-Samarrai Q. Psychological measurement and evaluation in soccer. Baghdad: Dijlah Library; 2023.
3. Al-Kaabi H. Levels of psychological burnout among Iraqi Premier League players. Al-Qadisiyah Journal for Physical Education Sciences. 2025;22(1):45-60.
4. Allawi MH. Sports psychology and competition. Cairo: Dar Al-Ma'arif; 2021.
5. Bishop CM. Pattern recognition and machine learning. Springer; 2006.
6. Goodfellow I, Bengio Y, Courville A. Deep learning. MIT Press; 2016.
7. Hassan A, Ali M. Artificial Intelligence applications in sports performance analysis: A systematic review. International Journal of Sports Science & Coaching. 2024;19(2):112-128.
8. Hughes M, Franks IM. Notational analysis of sport. Routledge; 2004.
9. Lazarus RS. How emotions influence performance in competitive sports. The Sport Psychologist. 2000;14(3):229-252.
10. Eysenck MW, Calvo MG. Anxiety and performance: The processing efficiency theory. Cognition & Emotion. 1992;6(6):409-434.
11. LeCun Y, Bengio Y, Hinton G. Deep learning. Nature. 2015;521:436-444.
12. Martens R, Vealey RS, Burton D. Competitive anxiety in sport. Human Kinetics; 1990.
13. Memmert D. The mental game of football: Offensive and defensive cognition. Routledge; 2021.
14. O'Donoghue P. Research methods for sports performance analysis. Routledge; 2010.
15. Reilly T. Science and soccer: Developing elite performers. 4th ed. Routledge; 2023.
16. Schmidt RA, Lee TD. Motor learning and performance. Human Kinetics; 2019.
17. Thomas JR, Nelson JK. Research methods in physical activity. Human Kinetics; 2015.
18. Wilson M. From processing efficiency to attention control: A mechanistic account of the anxiety-performance relationship. International Review of Sport and Exercise Psychology. 2008;1(2):184-201.